MaineDOT Fish Passage Policy and Design Guide: 2004 Annual Report

Prepared by:

MaineDOT Fish Passage Steering Committee

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1.0 History and Purpose

During the 1990s, the Maine Department of Transportation's (MaineDOT's) two-year program expanded substantially to include more total miles of projects to be completed within the two-year funding cycle. Design technologies, environmental permit processing and construction requirements developed steadily. In addition, less expensive drainage repair strategies were developed that can change the flow and passage characteristics of a structure. Addressing all of these changes together during project development had increasingly become more complex and MaineDOT recognized that protocols were needed to consistently address fish passage in context with existing regulations and policies, interagency coordination, design practices, cost, and project schedules.

In 1999, MaineDOT convened and led a multiagency Fish Passage Work Group (Work Group), recognizing that consensus was necessary to address fish passage while producing better projects more efficiently. Cooperating agencies included:

- Maine Atlantic Salmon Commission (MASC)
- Maine Department of Environmental Protection
- Maine Department of Inland Fisheries and Wildlife (MDIFW)
- Maine Department of Marine Resources (MDMR)
- Maine Land Use Regulation Commission
- National Marine Fisheries Service
- Natural Resources Conservation Service
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service

To identify ways to reach this goal, the Work Group examined current regulations and policies, current practices in agency coordination, existing standards for fish passage, fish species likely to be present and their passage needs, and engineering design and construction considerations. After examining these items, the Work Group developed recommendations for installing and repairing water-crossing structures in a way that:

- Complied to the extent practicable with current state and federal regulations on fish passage (Maine Natural Resources Protection Act and Land Use Regulation Commission guidelines, Federal Endangered Species Act, Magnuson-Stevens Fishery Management Act, and Clean Water Act);
- Included clear protocol for nature and timing of agency coordination;
- Enabled the Department to make use of new and developing technologies such as slip lining, plastic pipes, and concrete invert lining;
- Considered cost and other impacts;
- Reiterated MaineDOT's commitment to providing and coordinating fish passage; and
- Developed a base for biologic and hydrologic approaches to maintaining fish passage.

The outcome was MaineDOT's first Fish Passage Policy and Design Guide (Policy and Design Guide),

released in March 2002. This document established a policy, process, and design guide with best management practices for fish passage and was specifically developed for MaineDOT projects with water-crossing structures. These structures include pipes or boxes of varying types and sizes, commonly referred to as bridges, as well as struts, culverts, pipes or pipe arches (with or without footings), and can be part of any MaineDOT program. This document provided the framework, guidance and tools to process crossing projects by balancing a variety of natural resource and engineering parameters at any given site. As a living document, it continues to guide MaineDOT staff and coordinating agency representatives to develop and implement effective fish passage that meets regulatory requirements and resource needs, while delivering safe, cost-effective, and timely projects.

Related activities during 2002 were included in the first annual report and reviewed with federal and state resource and regulatory agencies (MaineDOT, 2003). Since then, MaineDOT has used the Policy and Design Guide to design and build fish passage measures. Ongoing experiences will be used to improve the original document, allowing MaineDOT to add or retain effective strategies and discard those that were ineffective.

2.0 Accomplishments in 2004

Among the major accomplishments for 2004 are the release of the 2nd Edition of the MaineDOT Fish Passage Policy and Design Guide, as well as the Annual Report of active projects and activities during 2003 (MaineDOT 2004). These reports, and additional work from 2004, are explained in the following sections.

2.1 2nd Edition Policy and Guide

Throughout 2004, MaineDOT continued to use the policy section of the Policy and Guide for project processing and technical assistance during design and construction, with good results. However, after meeting with New Brunswick, Canada officials in 2003, MaineDOT's approach to design was altered toward what is a sounder and more predictable method. As a result, the *2nd Edition of The Maine Department of Transportation Fish Passage Policy and Design Guide* was released in December 2004, and can be found at MaineDOT's website at http://www.maine.gov/MaineDOT/environmental-office-homepage/other_environmental.php.

One notable change in the 2nd Edition is the endorsement of in-culvert pool-and-weir configurations as the preferred method for achieving adequate water depths in culverts when the normal pipe hydraulics are insufficient. This approach is based on the experience and success of transportation and resource agencies in Maritime Canada. The 2nd edition also outlines improvements to processing (refer to Figure 1 in the 2nd Edition), which includes review by fisheries agencies earlier in the life of a project and improved reporting tools.

Finally, *The MaineDOT Fish Passage Policy and Design Guide 2003 Annual Report* was completed in March 2004. This report can also be found at MaineDOT's website, using the link above.

2.2 Steering Committee Updates

The Steering Committee is responsible for assuring the Policy and Guide is kept up-to-date; improving

it as more is learned about passing fish by research, networking, and experience; and implementing and sustaining the document's use by MaineDOT staff who assess, design, and construct fish passage. Over the past year, John Perry has become a new member of the steering committee, replacing Bob Van Riper who took a position with MDIFW. The current Committee is comprised of the following individuals:

Richard Bostwick, Chief Biologist/Agency Coordination
Charles Hebson, Chief Hydrologist
Michael Wight, Bridge Engineer
Brian Kittridge, Highway Designer
John Perry, Biologist
Peter Newkirk, Environmental Engineer
Sylvia Michaud, Chair/Policy

2.3 Monitoring

Site-specific monitoring is conducted at sites that have been retro-fitted for fish passage. Monitoring includes an initial baseline inventory of habitat parameters before construction, followed by two years of post construction monitoring. Monitoring measures assess the efficacy of the technology to allow fish to pass through a structure by creating suitable conditions for passage. Baseline data measured include photographs, water depth and velocity, presence of other physical barriers to passage, and assess overall site conditions (i.e. stability, direct observations of fish using structures to pass). If measurements imply fish passage is possible at the site, it is assumed that fish are passing during critical periods and that project commitments for fish passage have been met. Additional monitoring protocol is considered on a case-by-case basis. If, during or at conclusion of the monitoring period, any site appears impassable, MaineDOT will assess the problem and recommend remedial measures as appropriate, consulting with fisheries and regulatory agencies to resolve project issues.

Future monitoring may include mark and recapture studies, as well as electrofishing surveys, in conjunction with fisheries agencies.

3.0 Projects Constructed in 2004

The following are summaries of projects that were constructed in 2004, with location maps included as Appendix A. While the project summaries have been edited to include basic information relating directly to this report, more information is available upon request.

3.1 Fairfield, Fish Brook Bridge # 6218 PIN 011098.00 (Route 104/139 over Fish Brook)

Prior Condition: The preexisting bridge was a 12-ft. diameter steel pipe with heavily rusted bottom and drop at the outlet.

Current Condition: The structure was rehabilitated with concrete invert lining and the addition of in-pipe weirs at the downstream end of the pipe. Construction was completed in fall 2004.

Commenting agencies: MDMR, MDIFW

Structure designed to pass the following species: brook trout, American eel

Future action/monitoring: Post construction monitoring to begin in 2005. Proposed monitoring includes mark-and-recapture electrofishing surveys in conjunction with MDIFW Region B biologists.

Lessons learned: The designer recommends that the weirs should be spaced further apart on future projects. However, monitoring will need to be conducted to determine the efficacy of the as-built structure.

3.2 Westbrook, Mill Brook Hill Bridge #5749, PIN 009031.00 (Austin Street over Mill Brook)

Prior Condition: The preexisting bridge consisted of two 10-ft. diameter steel pipes. The bottom plates were heavily rusted with many holes. The fish passage concern was a small drop at the outlet of the pipes. Due to the high associated utilities costs for a replacement project, culvert rehabilitation with weirs was the selected alternative.

Current Condition: Construction was completed in late fall 2004.

Commenting agencies: MDMR, MASC

Structure designed to pass the following species: alewife, Atlantic salmon (future concerns)

Future action/monitoring: Post construction monitoring to begin in 2005. Proposed monitoring includes qualitative observations of use by migrating alewives in conjunction with MDMR fishway counts at the Highland Lake Dam upstream.

Lessons learned: Excavation for the downstream weirs was difficult due to lack of access for heavy equipment, so the excavation was done by hand with buckets. Constructability needs to be considered during the preliminary design. The contractor could not complete the work within the original instream work window. Future projects with constructability issues should have large enough instream work window to build the project.

4.0 Projects monitored in 2004

Several projects were monitored in 2004 for fish passage efficacy. These projects are listed in Table 1; summaries of each project are included below. Site specific conditions that were monitored include fish species present, stream gradient, slope of structure, water depth within structure, and water velocity. Location maps for these projects are included as Appendix B.

Table 1. Projects Monitored in 2004

Project	Location	Species
PIN 5220.10	Fort Kent	brook trout
Region 2, Rt. 52	Lincolnville	brook trout
PIN 10803.00, Rt. 16/27	Carrabassett Valley	brook trout
PIN 10802.00	Sebago	rainbow smelt, brook trout
PIN 10049.00	Linneus	brook trout
Belgrade Road	Mount Vernon	brook trout

4.1 Wallagrass-Fort Kent, PIN 5220.10, Rt. 11, Pinette Brook (2003)

Prior condition: The preexisting structure consisted of twin 36-in. pipes, 50-ft. long each. The pipes needed replacing because they were too short and too small for the redesign. In addition the area was reviewed for drainage needs and therefore required a larger diameter to meet modern standards.

Current condition: Installed a new 7-ft. x 40-in. structural pipe plate arch, approximately 95 ft. long, with approximately 6-8 in. hang at outlet due to shallow ledge. The downstream pool elevation was raised to match culvert elevation by installing a weir of non-woven geotextile fabric and rip rap in the downstream pool. The stream elevation at outlet of downstream pool was also raised sufficiently to pass fish. However, some rip rap scoured and moved around within the downstream pool, exposing a small area of geotextile fabric, but has not compromised structural integrity of weir.

Commenting agencies: MDIFW

Structure designed to pass the following species: brook trout

Future action/monitoring: Will continue to monitor site conditions to ensure weir continues to function as intended and allows fish to pass. Final monitoring to occur in 2005.

Lessons learned: Use larger rip rap or install a more permanent structure such as concrete Jersey barrier weir.

4.2 Lincolnville, Region 2, Rt. 52, Unnamed inlet to Pitcher Pond (2003)

Prior condition: The preexisting structure consisted of a 60-in. round corrugated metal pipe located 0.8 mi. south of the Northport town line. Preexisting problems at the site included the historic relocation of meander to cross perpendicular to roadway; winter sand buildup and minor side slope failures, and down cutting which created an 18-in. vertical drop at the structure outlet. Stream substrates ranged from pea-sized gravel to boulders. MDIFW identified excellent potential for

foraging and reproducing brook trout migrating from Pitcher Pond. Recommendations: place new structure to better align with stream geometry, reduce vertical drop for suitable passage, shape upstream channel to fit with reach meanders, and build resting pools for fish.

Current condition: A new 72-in. round corrugated metal pipe was placed at less than average gradient with invert elevation below existing streambed. The upstream channel was machine-graded to match natural was used vertical and horizontal stream geometries. Vertical and horizontal skewing better aligns new culvert with stream and partially dissipates outlet energy because vertical drop extends over longer distance in channel. Stone of various sizes was used to stabilize the upstream channel, and relocated by hand to create low-to-moderate discharge channel. Six resting pools were excavated by hand. Both the discharge channel and resting pools are currently stable. The channel relocation increased shading by mature softwoods upstream. Increased the size and placement of stone weir materials intended to raise pool elevations and back water into pipe. Downstream pool outlet somewhat distorted (will be followed up and adjusted as necessary).

Commenting agencies: MDIFW

Structure designed to pass the following species: brook trout

Future action/monitoring: Will monitor channel stability and reestablished vegetation between new channel and toe of road shoulder through 2005. The stone at outlet of downstream pool will be checked and stabilized as needed. Despite potential blockage downstream, brook trout spawning surveys to be conducted in the fall.

Lessons learned: Currently, two privately owned culverts under a camp access road block downstream access for fish. While this was discovered prior to construction, MDIFW felt it was possible that these culverts might be replaced at some point in the future.

4.3 Carrabassett Valley, PIN 10803.00, Rt. 16/27, Unnamed Tributary to Carrabassett River (2003)

Prior condition: The preexisting structure was an 84-in. multiplate corrugated pipe. The pipe was in poor condition with holes at and below the waterline. In addition, there was a 6-in. vertical drop at the outlet. The structure is located 60 ft. upstream of the confluence with South Branch Carrabassett River, 2.1 miles north of the Kingfield town line (adjacent to northern boundary of the MaineDOT Rest Area). Larger flows are under hydrologic control of Carrabassett River (backwater condition). Substrates predominantly sand and pea-sized gravel upstream, hand-to-head-sized cobble downstream. There is some minor undercutting upstream. Two remnant and one active beaver dam are located upstream. No fisheries issues were identified by MDIFW regional staff; therefore, the site was chosen as experimental location to expand brook trout habitat from Carrabassett River.

Current condition: The structure was rehabilitated with a grouted plastic slip liner with smooth interior, with a downstream pool/weir at the outlet. The weir consists of a flat-bottomed v-notch weir (6 in.) constructed of two concrete Jersey barriers, connected by reinforced concrete, and embedded 3 ft. into stream bank above the normal water line. It was also set a minimum of 2 ft. into the substrate. Stone channel protection and drop-pools downstream of weir outlet. The weir was structurally sound,

with the notch drop approximately equal to that of the outlet. The northwest side of the structure has settled approximately 1.5 in., allowing overtopping flow at moderate discharge levels. The downstream drop-pools were in fair condition. During two post-construction site visits, the rocks forming the pools were relocated to improve the pool configuration.

Commenting agencies: MDIFW

Structure designed to pass the following species: brook trout

Future action/monitoring: Post construction monitoring through 2005, including brook trout use of upstream habitat.

Lessons learned: In coarse bed materials, bedding of weir structure with finer graded material may be necessary. Compacting bedding material should be standard procedure.

4.4 Sebago, PIN 10802.00, Rt. 11/114, Bachelder Brook (2003)

Prior condition: The preexisting structure consisted of a granite box culvert with outlet baffle sluice which was not maintained and was not effective. The invert elevation was approximately 2 ft. above the normal high water mark of Sebago Lake. The new road design shortened the radius of the road curve; therefore, the stream channel needed to be relocated. The proposed design called for a relocation of a portion of brook, and the installation of four log drop weirs (riffle-pool) to allow fish passage and as grade control for flows in the shortened channel.

Current condition: A new 9-ft. diameter corrugated aluminum pipe was embedded (after removing ledge) at 1 ft. below the normal high water mark of Sebago Lake. The final design substituted granite weirs for log drop structures to reuse material from demolition of granite box and reduce future maintenance needs. New culvert designed with 3% gradient. Slightly more ledge removed during construction than anticipated resulting in 2.5% gradient; therefore, the new channel was graded to match. Lower inlet invert required two additional weirs, for a total of six weirs upstream. The riparian zone between the new channel and roadway toe-of-slope was re-vegetated with variety of plants for future channel shading. The new channel was currently stable after several rain events and high flows

including a $Q_{1.5}$ event on 10/28/03. The channel is evolving as sediment loads from upstream areas migrate through system, changing pool and riffle depths as channel moves towards equilibrium. Brook trout were observed in the new channel.

Commenting agencies: MDIFW

Structure designed to pass the following species: rainbow smelt, brook trout

Future action/monitoring: Monitoring through 2005 will include observation of channel evolution and potential for brook trout and/or adult smelt migration to upstream habitat.

Lessons learned: Pending

4.5 Linneus, Bither Brook Bridge #3709, PIN 10049.00, Rt. 2A over Bither Brook (2003)

Prior Condition: The preexisting structure was a 103-ft. long, 9-ft. diameter steel pipe with 0.4% slope. The bottom of the pipe was heavily rusted with some holes. There was inadequate water depth inside the pipe during summer and an approximately 6 in. drop at the outlet.

Current Condition: The pipe was sliplined with an 8-ft. diameter aluminum pipe. Concrete weirs and baffles were added inside the pipe to insure adequate depth of water. Two log drop grade control structures were installed downstream to eliminate the drop at the outlet.

Commenting agencies: MDIFW, MASC

Structure designed to pass the following species: brook trout, Atlantic salmon (future concerns)

Future action/monitoring: Post construction monitoring until 2005. Additional weir may need to be created downstream of the existing weir to accommodate sheet flow conditions over culvert apron.

Lessons learned: Need to monitor the downstream weirs. The stream may try and create a new low flow channel around the weirs in the long term. The notch in the log weirs was cut narrower than what was shown on the design plans. Future monitoring may indicate a need to adjust the weir opening.

4.6 Mount Vernon, Region 2, Belgrade Road, Unnamed tributary to Long Pond (2002)

Prior condition: The preexisting structure was a 30-in. diameter corrugated metal pipe located 1.6 miles southwest of the Rome town line. Several ledge drops upstream created an alternating braided, drop/pool channel. There was a 3-ft. outlet drop over ledge and large woody debris. The stream bisects around a boulder about 15-ft. downstream. The downstream channel is riffle/pool with extensive bank undercutting and large woody debris. Per MDIFW, the stream had a historic resident population of brook trout. Several trout were observed downstream. MDIFW recommended that a new culvert be installed at a lower elevation and to construct outlet grade control structures to alleviate downstream drop.

Current condition: The new crossing consists of a 36-in. diameter corrugated metal pipe. Region 2 Maintenance blasted the ledge to lower the invert elevation as much as possible and machine-shaped the upstream channel to match. Six stone drop pools were constructed downstream to moderate the existing 3-ft. drop. The pool directly below the outlet was constructed of 14-in. diameter stone underlain by non-woven geotextile. The geotextile was anchored by stone, filled with bark mulch and cobble, and wrapped over a base layer of stone. A notched was created at downstream low point of pool. The first pool backed water 30 ft. into the new pipe. A series of pools were built within the eastern portion of channel below the outlet of first pool. Geotextile was placed over a base layer of stone, anchored by additional stone and formed into rough pool configuration with 6-5n. drops at each outlet. The final shapes of the pools were constructed using a mixture of bark mulch and cobble

wrapped in fabric, with additional rock over that. The area upstream of the pipe has accumulated and lost material consistent with adjacent upstream reaches. The stream originates in a large wetland with limited storage, so during snowmelt and large precipitation events large flows have passed through the pipe. Volume and velocity of water during these large events are very high; larger stones cannot be used for drop pools because of the small channel (average 3 ft. wide).

Commenting agencies: MDIFW

Structure designed to pass the following species: brook trout

Future action/monitoring: Consulted with MDIFW and it was decided to retrofit the structure with small concrete barriers, similar to Jersey barriers, but only 4 ft. long by 2 ft. high. Expect to install summer 2005.

Lessons learned: Geotextile wrapped bark mulch and cobble was tried as a mass anchor, with more resistance to flow than individual rocks. Bark mulch in mix was an attempt to use natural materials to "seal" the downstream end of the pools. The intent was that when the mulch became saturated, it would be more efficient at catching sediment. Although this may work in lesser gradient, lower volume streams, it did not perform here.

5.0 Projects to be monitored in 2005

The following projects in **Table 2** are scheduled for monitoring in 2005. Timing and duration of monitoring will be dependent on species to be passed, as well as climatic conditions (i.e. projects may be monitored after high flow events or during periods of extreme low flow). Location maps for these projects are provided as Appendix C.

Table 2. Projects Scheduled for Monitoring in 2005

Project	Location	Species	Proposed Monitoring Activity	Proposed Dates
Fish Brook Bridge, PIN 011098.00	Fairfield	brook trout	Electrofishing of clipped brook trout released in the spring (in conjunction with MDIFW)	Summer-fall
Mill Brook Hill Bridge, PIN 009031.00	Westbrook	alewife	Qualitative observations in conjunction with MDMR counts at Highland Lake Dam upstream	Spring, fall
Bither Brook Bridge, PIN 10049.00	Linneus	brook trout	Electrofishing upstream habitat for brook trout use	Summer-fall
Bachelder Brook, PIN 10802.00	Sebago	smelt, brook trout	Early spring survey for upstream smelt spawning activity; summer-fall survey for brook trout	Early spring (April) for smelt Summer-fall for brook trout
Carrabassett Valley, PIN 10803.00	Carrabassett Valley	brook trout	Electrofishing for brook trout upstream of structure, fall spawning surveys	Summer-fall
Lincolnville Rt. 52,	Lincolnville	brook trout	Fall brook trout spawning surveys	Fall
Wallagrass-Fort Kent Rt. 11, PIN 5220.10	Fort Kent	brook trout	Electrofishing upstream habitat for brook trout use	Summer-fall

6.0 Projects Scheduled for Construction in 2005

The following projects are scheduled to be constructed during the 2005 season. Environmental staff will be on hand during construction of fish passage structures. Pending completion dates and species concerns, field monitoring may take place for these structures in 2005.

6.1 Camden, Spring Brook Bridge, PIN 010128.00

Existing condition: This project was originally slated as concrete box culvert rehabilitation. Existing concrete bottom slab was to be raised by addition of new concrete. Fish passage concerns were due to the lack of adequate depth and a hanging outlet. The possibility of adding weirs was also considered. The regulatory agencies requested additional grade control structures outside the right of way limits due to shallow flow over some ledges. This area of shallow flow downstream from the bridge would prevent fish from getting to the bridge. Because transportation funds can not be used for structures outside the right of way, the decision was made to change the project scope and not rehabilitate the bottom slab.

Commenting agencies: MDIFW

Structure designed to pass the following species: brook trout

Future action: Project scope was changed to eliminate all instream work. The current scope includes slope stabilization and new headwalls.

Commenting agencies: MASC, MDMR, MDIFW

6.2 Eddington, Grant Bridge # 5414, PIN 011094.00 (Route 178 over Meadow Brook)

Existing condition: The existing bridge is single 17'-0" span by 11'-2" rise by 96' long steel structural plate pipe arch built in 1975. The pipe arch is in poor condition with heavily rusted bottom plates and some holes through the bottom plates. The pipe arch had inadequate water depth inside during summer and an approximately 1-ft. drop at the outlet.

Commenting agencies: MDMR, MASC

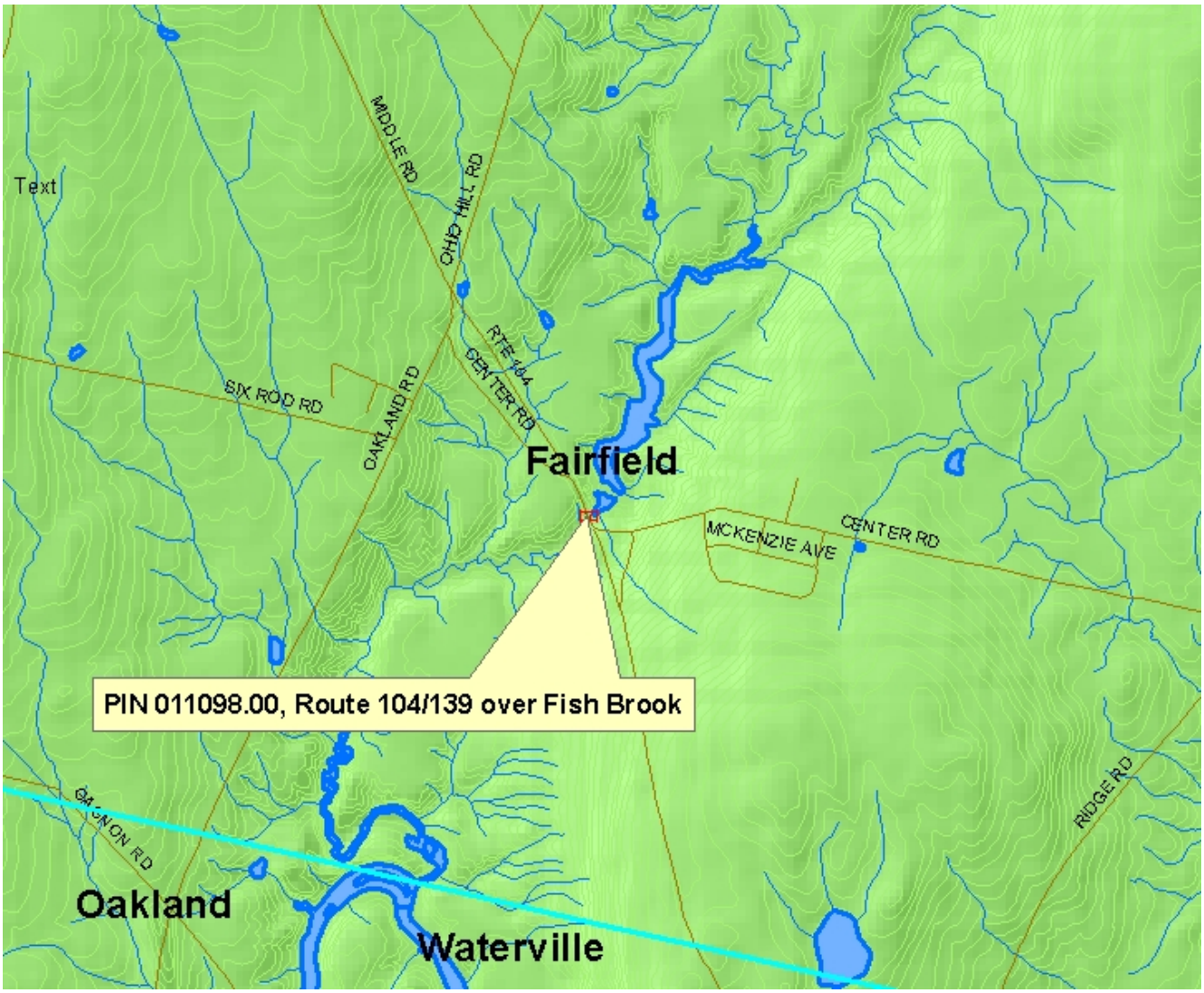
Structure designed to pass the following species: Atlantic salmon, American eel, blueback herring

Future action: Proposed project is concrete invert lining with six additional concrete weirs. Five weirs will be constructed inside downstream end of pipe arch to form series of 6' by 6' pools. The remaining weir will be located outside the pipe. No weirs or grade control structures will be used outside of the pipe arch. The project was advertised in February 2005 with construction to be completed by fall 2005.

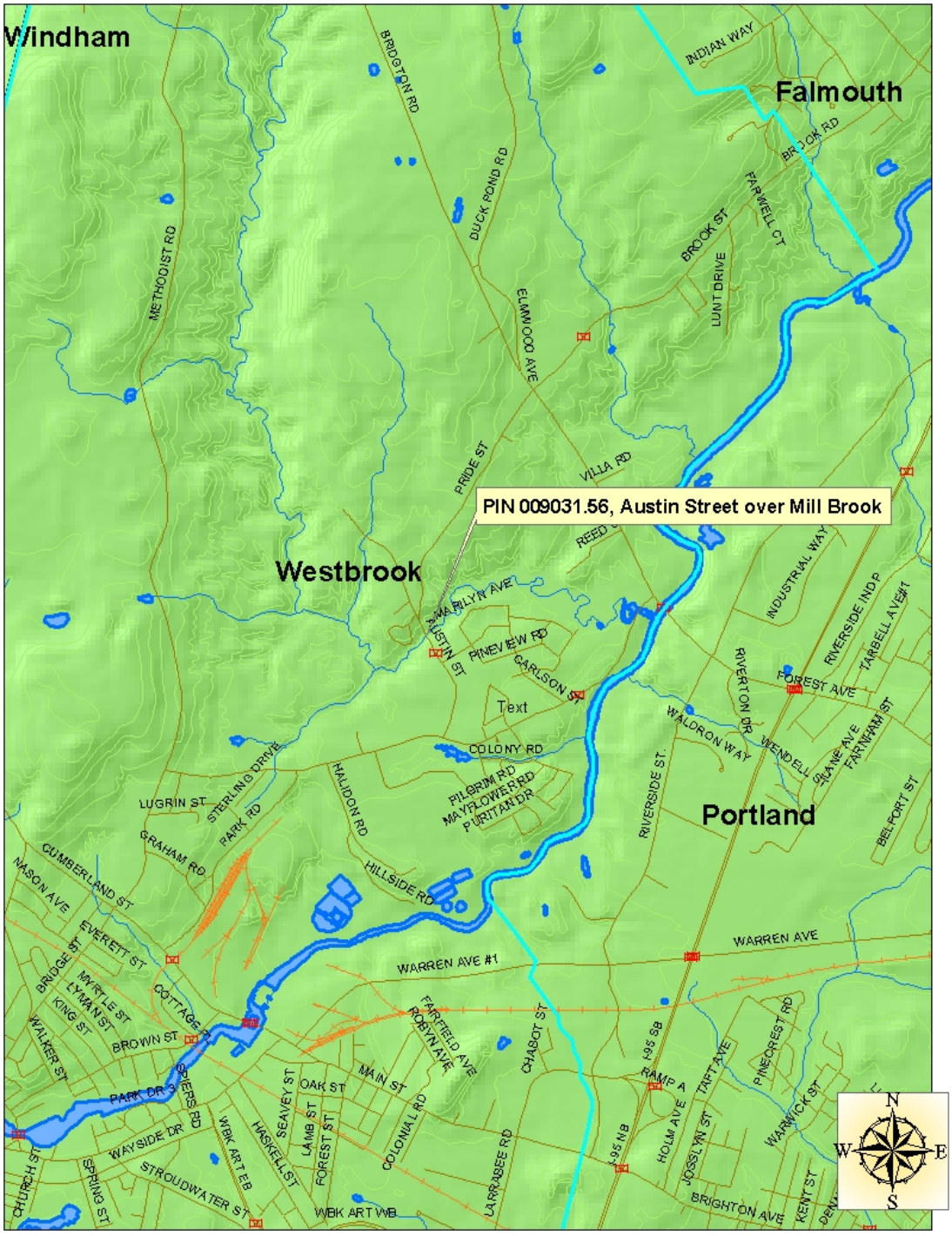
Lessons learned: Pending project completion.

Appendix A: Location Maps of Structures Built in 2004

Fish Brook, Fairfield

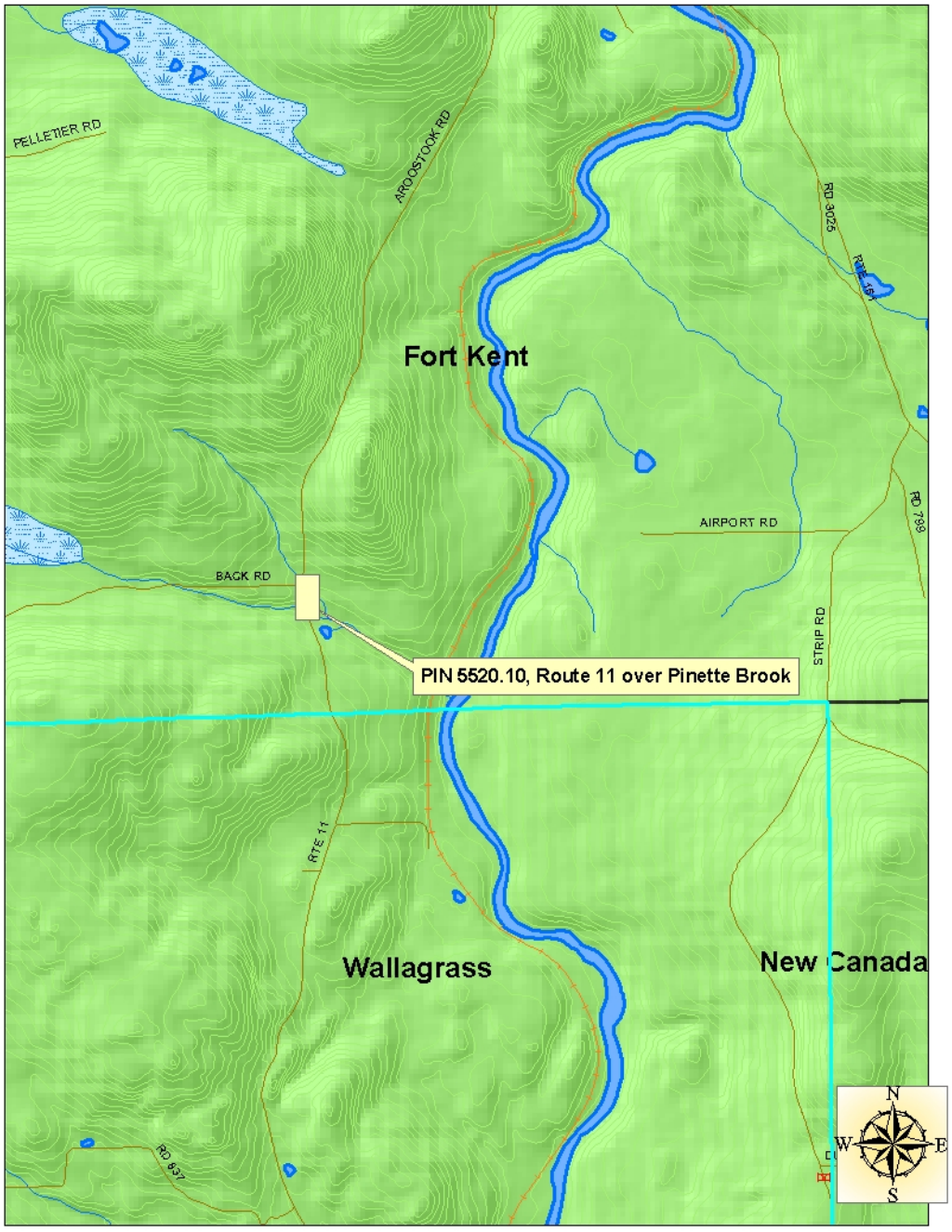


Mill Brook, Westbrook

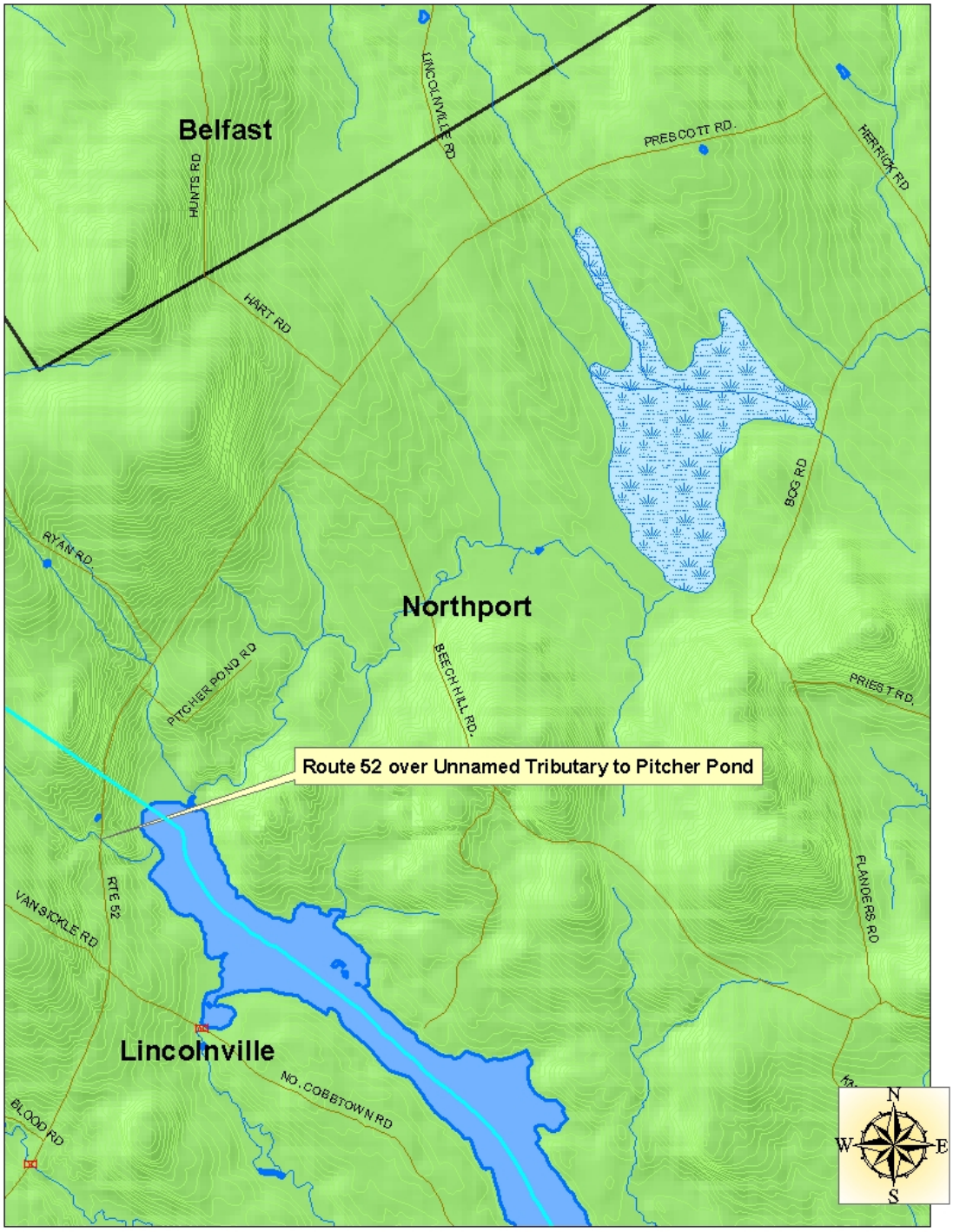


Appendix B: Location Maps of Structures Monitored in 2004

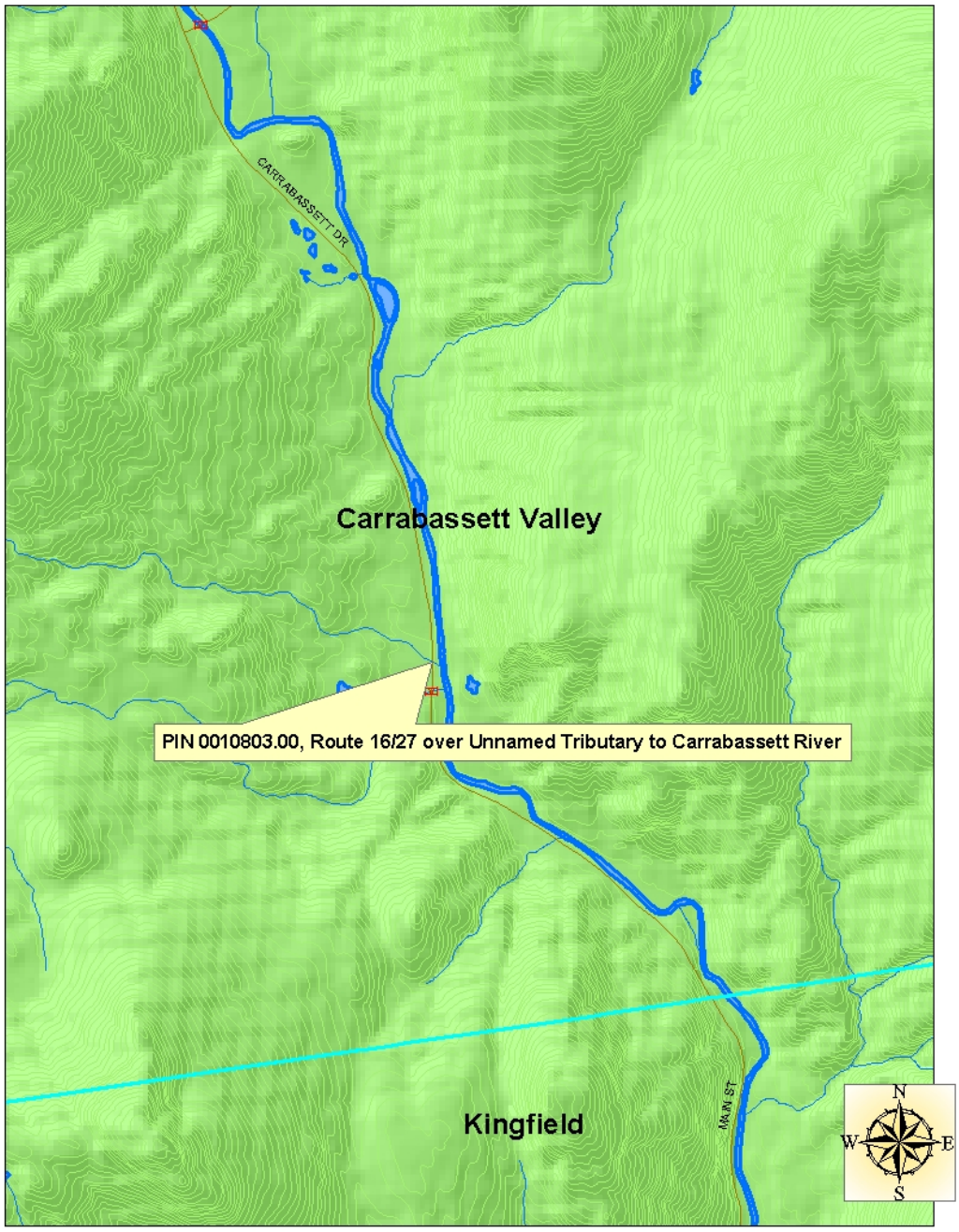
Pinette Brook, Wallagrass-Fort Kent



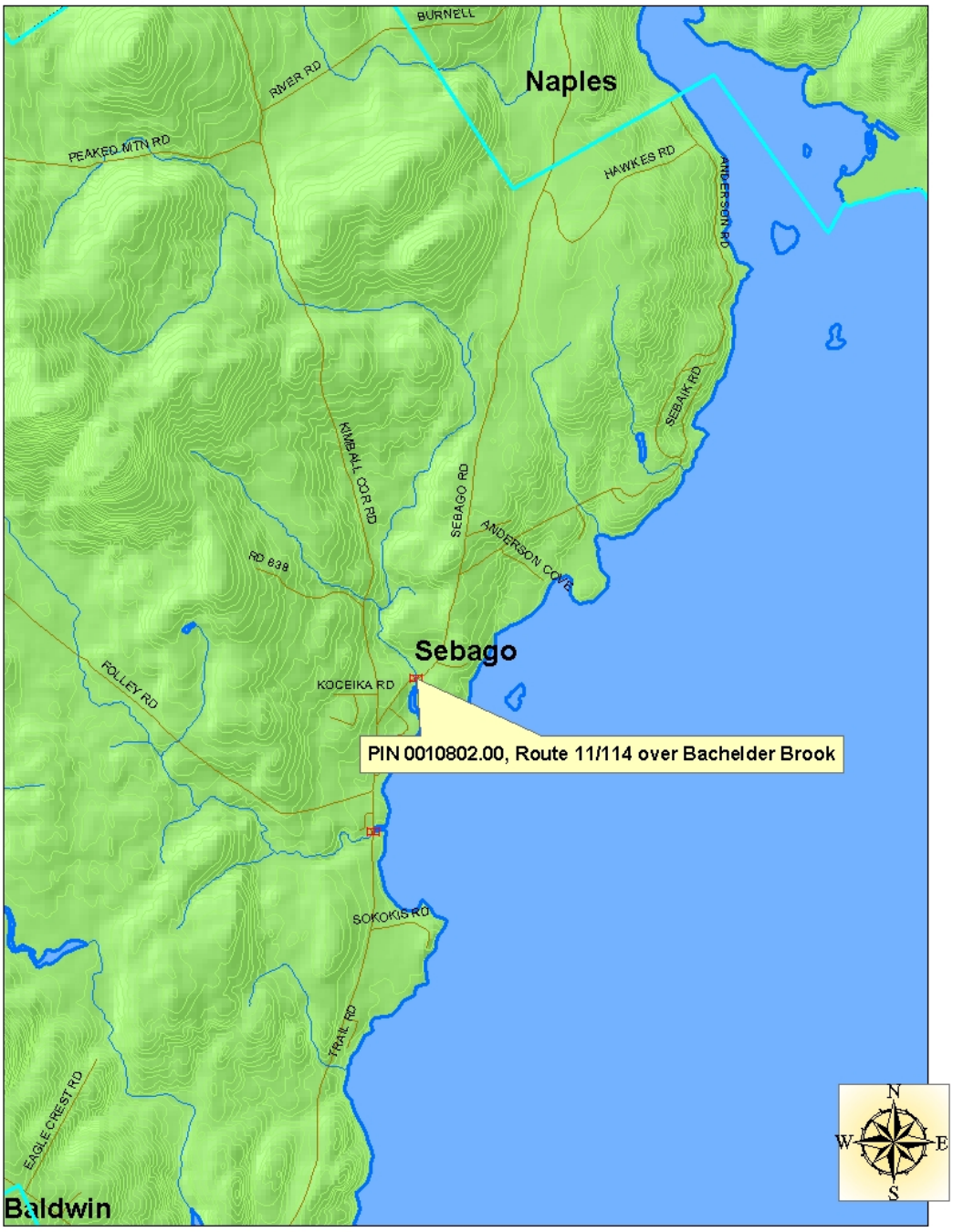
Unnamed Tributary to Pitcher Pond, Lincolnville



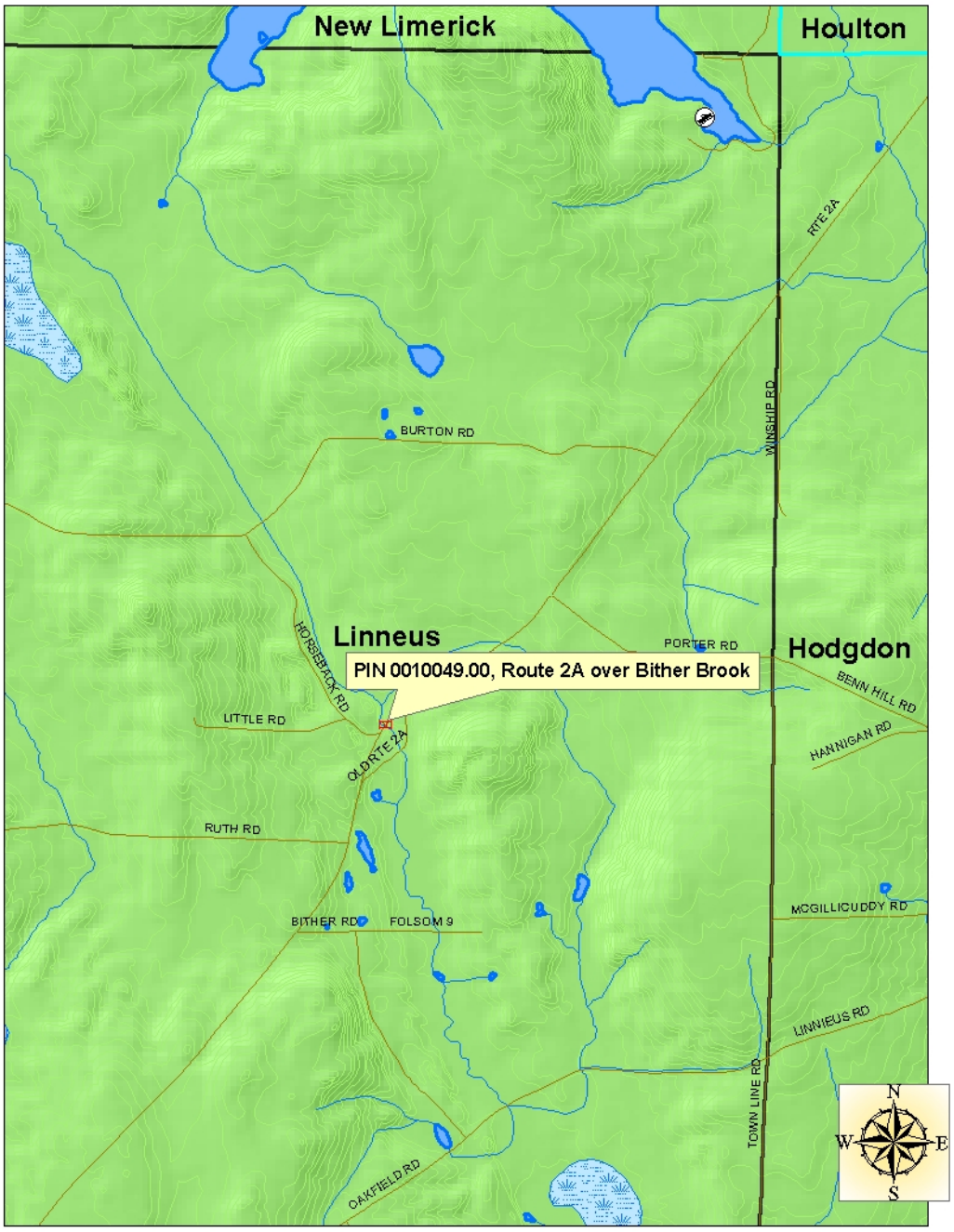
Unnamed Tributary to Carrabassett River, Carrabassett Valley



Bachelder Brook, Sebago



Bither Brook, Linneus



Unnamed Tributary to Long Pond, Mount Vernon

Appendix C: Location Maps of Structures to be built in 2005

Meadow Brook, Eddington